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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/644,957	08/21/2003	Gordon Bease	071469-0305396	7598

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EXAMINER

ARANCIBIA, MAUREEN GRAMAGLIA

ART UNIT	PAPER NUMBER
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1763

DATE MAILED: 03/17/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/644,957

Applicant(s)

BEASE ET AL

Examiner

Maureen G. Arancibia

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 21 February 2006.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-36 is/are pending in the application.
- 4a) Of the above claim(s) 17-36 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 20 July 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Continued Examination Under 37 CFR 1.114*

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 19 January 2006 has been entered.

### *Claim Rejections - 35 USC § 112*

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. **Claims 1-16 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.**

Specifically, the amendment to the independent claims to recite that the high-permittivity material is substantially free of silicon appears to add new matter to the claims, since there does not appear to be support in the original disclosure for the recitation that the high-permittivity material is substantially free of silicon. While some examples are silent as to the presence of silicon in the high-permittivity material, they are like wise silent as

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to the necessary absence of silicon. It has been held that negative limitations recited to overcome prior art can be considered new matter, and that the mere absence of a positive recitation in the original specification is not basis for the exclusion of a feature.

*Ex Parte Grasselli et al.* 231 USPQ 393.

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**5. Claims 1-10, 15, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,818,553 to Yu et al. in view of U.S. Patent 6,579,809 to Yang et al.**

Yu et al. teaches a method of processing a gate dielectric layer 14 containing a high-permittivity (high-k) material (Column 2, Lines 24-25) overlying a substrate 10, comprising providing said high-k layer (Column 2, Lines 24-25); modifying said high-k layer by exposing it to a plasma (Column 2, Line 63 - Column 3, Line 6); and wet etching to remove the modified high-k layer (Column 3, Lines 45-51).

In regards to Claims 1 and 10, Yu et al. does not expressly teach that the high-k material can be substantially free of Si, and specifically can comprise any of the materials recited in Claim 10.

Yang et al. teaches that a gate dielectric layer 62 to be etched can be TiO<sub>2</sub>, ZrO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, or HfO<sub>2</sub>. (Column 4, Lines 39-41; Column 5, Lines 5-9; Column 7, Lines 20-23)

It would have been obvious to one of ordinary skill in the art to modify the method taught by Yu et al. to form the gate dielectric layer of one of the materials taught by Yang et al. (none of which contain Si). The motivation for making such a modification, as taught by Yang et al. (Column 4, Lines 18-62), would have been to select a suitable material for the gate dielectric layer that has a dielectric constant greater than silicon dioxide and that "therefore provides capacitive coupling equivalent to an oxide thickness of one nanometer or less while maintaining an adequate physical thickness to prevent charge tunneling." Moreover, it has been held that the selection of a known material based on its suitability for its intended use is prima facie obviousness. *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

In regards to Claims 2 and 3, the modification performed by exposure to the plasma partially removes the high-k layer, thereby disrupting the atomic structure of the layer by removing part of it and leaving partially etched layer 14'. (Column 3, Lines 3-5; Figure 4)

In regards to Claim 4, Yu et al. teaches that the processing method comprises creating a plasma from a process gas comprising a reactive (fluorine-based) gas. (Column 3, Lines 33-45)

In regards to Claim 5, the combination of Yu et al. and Yang et al. discussed above does not expressly teach that the process gas can comprise at least one of HBr and HCl.

Yang et al. teaches that a high-k layer 62 (Column 5, Lines 7-9) can be etched with plasma created from a process gas comprising HBr. (Column 7, Lines 20-27)

It would have been obvious to one of ordinary skill in the art to modify the process gas taught by Yu et al. to comprise HBr, as taught by Yang et al. The motivation for doing so, as taught by Yang et al. (Column 7, Lines 22-23), would have been to make the etching conditions selective for the high-k material over an underlying silicon substrate.

In regards to Claims 6-9, Yu et al. further teaches that the process gas can comprise an inert gas such as helium or argon. (Column 3, Lines 14-16)

In regards to Claim 15, see the discussion of Claim 4.

In regards to Claim 16, see the discussion of Claim 4. Yu et al. additionally teaches that the modification performed by exposure to the plasma is anisotropic. (See Figure 4)

**6. Claims 11, 12, and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yu et al. in view of Yang et al. as applied to Claim 1 above, and further in view of U.S. Patent 6,536,449 to Ranft et al.**

The teachings of Yu et al. and Yang et al. were discussed above.

The combination of Yu et al. and Yang et al. does not expressly teach that a substrate holder exposing the substrate to the plasma should be RF powered (as recited in Claim 11), grounded (as recited in Claim 12), or electrically isolated (as recited in Claim 14).

Ranft et al. teaches a substrate holder 104 for use in a plasma etching method (Column 5, Lines 4-8) can be grounded (Column 5, Line 40), electrically isolated (Column 5, Lines 50-52); or RF powered (Column 5, Lines 57-58).

It would have been obvious to one of ordinary skill in the art to modify the method taught by the combination of Yu et al. and Yang et al. to ground the substrate holder (as recited in Claim 12), electrically isolate the substrate holder (as recited in Claim 14), or RF power the substrate holder (as recited in Claim 11). The motivation for grounding the substrate holder, as taught by Ranft et al. (Column 5, Lines 40-50), would have been to etch with higher currents and energies of ion bombardment. The motivation for electrically isolating the substrate holder, as taught by Ranft et al. (Column 5, Lines 50-54), would have been to decrease ion bombardment on the substrate, i.e. to have a gentler etch process. The motivation for supplying RF power to the substrate holder, as taught by Ranft et al. (Column 5, Lines 57-60), would have been to accelerate ions toward the substrate to enhance etching.

**7. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yu et al. in view of Yang et al. as applied to Claim 1 above, and further in view of U.S. Patent Application Publication 2001/0003271 to Otsuki.**

The teachings of Yu et al. and Yang et al. were discussed above.

The combination of Yu et al. and Yang et al. does not expressly teach that a substrate holder exposing the substrate to the plasma should have a DC bias.

Otsuki teaches that a substrate holder 24 that exposes a substrate W to a plasma (Paragraph 57) can have a DC bias. (Paragraph 48)

It would have been obvious to one of ordinary skill in the art to modify the method taught by the combination of Yu et al. and Yang et al. to supply the substrate holder with

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a DC bias, as taught by Otsuki. The motivation for doing so, as taught by Otsuki

(Paragraph 48), would have been to electrostatically attract the substrate to the holder.

### ***Double Patenting***

8. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

**9. Claims 1-16 are provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 93 and 95-104 of copending Application No. 10/670,795 ('795) in view of Yu et al., Ranft et al., and Otsuki.**

In regards to Claim 1, Claim 104 of '795, which depends on Claim 93 of '795, recites a method of processing a provided layer containing a high-permittivity material, comprising modifying the layer by exposing it to a plasma, and etching the modified layer in the absence of plasma. Claim 104 of '795 recites that the high-permittivity material can be any of the Si-free materials recited in Claim 10 of the instant application.

Claim 104 of '795 does not recite that the etching step should be a wet etching, or that the etching step can remove the modified layer.



Yu et al. teaches that a plasma-modified high-permittivity (high-k) layer can be removed by wet etching (Column 3, Lines 45-51).

It would have been obvious to one of ordinary skill in the art to modify the method recited in Claim 104 of '795 to make the etching step a wet etching, and to remove the modified layer during the etching step. The motivation for making the etching step a wet etching, as taught by Yu et al. (Column 3, Line 66 - Column 4, Line 10), would have been to perform a selective etch that does not require masking of the substrate and does not damage other features of the substrate (ex. source/drain areas). The motivation for using the etching step to remove the modified layer, as taught by Yu et al. (Column 3, Lines 52-54) would have been to define a feature (ex. a gate electrode) on the substrate.

In regards to Claim 2, Claim 96 of '795 recites that the modifying step partially removes the high-permittivity layer.

In regards to Claim 3, Claim 97 of '795 recites that the modifying step partially disassociates the high-permittivity layer, which would disrupt the atomic structure of the layer.

In regards to Claim 4, Claim 95 of '795 recites that the substrate is provided in a process chamber, while Claim 98 of '795 recites that the process gas that creates the plasma comprises a reactive gas.

In regards to Claims 5-9, Claims 99-103 of '795 recite the claimed limitations.

In regards to Claims 11, 12, and 14, the combination of Claim 104 of '795 and Yu et al. as applied to Claim 1 does not expressly teach that a substrate holder exposing

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the substrate to the plasma should be RF powered (as recited in Claim 11), grounded (as recited in Claim 12), or electrically isolated (as recited in Claim 14).

Ranft et al. teaches a substrate holder 104 for use in a plasma etching method (Column 5, Lines 4-8) can be grounded (Column 5, Line 40), electrically isolated (Column 5, Lines 50-52), or RF powered (Column 5, Lines 57-58).

It would have been obvious to one of ordinary skill in the art to modify the method taught by the combination of Claim 104 of '795 and Yu et al. as applied to Claim 1 to ground the substrate holder (as recited in Claim 12), electrically isolate the substrate holder (as recited in Claim 14), or RF power the substrate holder (as recited in Claim 11). The motivation for grounding the substrate holder, as taught by Ranft et al. (Column 5, Lines 40-50), would have been to etch with higher currents and energies of ion bombardment. The motivation for electrically isolating the substrate holder, as taught by Ranft et al. (Column 5, Lines 50-54), would have been to decrease ion bombardment on the substrate, i.e. to have a gentler etch process. The motivation for supplying RF power to the substrate holder, as taught by Ranft et al. (Column 5, Lines 57-60), would have been to accelerate ions toward the substrate to enhance etching.

In regards to Claim 13, the combination of Claim 104 of '795 and Yu et al. as applied to Claim 1 does not expressly teach that a substrate holder exposing the substrate to the plasma should have a DC bias.

Otsuki teaches that a substrate holder 24 that exposes a substrate W to a plasma (Paragraph 57) can have a DC bias. (Paragraph 48)

It would have been obvious to one of ordinary skill in the art to modify the method taught by the combination of Claim 104 of '795 and Yu et al. as applied to Claim 1 to supply the substrate holder with a DC bias, as taught by Otsuki. The motivation for doing so, as taught by Otsuki (Paragraph 48), would have been to electrostatically attract the substrate to the holder.

In regards to Claim 15, see the discussion of Claims 1 and 4.

In regards to Claim 16, see the discussion of Claims 1 and 4.

The combination of Claims 104 of '795 and Yu et al. discussed above does not expressly teach that the plasma modification step should proceed anisotropically.

However, Yu et al. further teaches that a plasma modification of a high-permittivity (high-k) layer can take place anisotropically. (See Figure 4)

It would have been obvious to one of ordinary skill in the art to perform the plasma modification step anisotropically, as taught by Yu et al. The motivation for doing so would have been to form smooth vertical sidewalls to define features on the substrate.

**This is a provisional obviousness-type double patenting rejection.**

#### ***Response to Arguments***

10. Applicant's arguments filed 19 January 2006 have been fully considered but they are not persuasive.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208

USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

In regards to applicant's preemptive argument against the combination of Yu et al. with Yang et al. or any other reference of record, it seems that applicant is arguing that Yu et al. is nonanalogous art due to the teaching of high-k materials containing Si. The examiner responds that it has been held that a prior art reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the applicant was concerned, in order to be relied upon as a basis for rejection of the claimed invention. See *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). In this case, Yu et al. is in the field of applicant's endeavor, processing high-k materials.

In regards to applicant's argument against the obviousness-type double patenting rejection, the examiner recognizes that the dry etching step recited in Claim 104 (which depends on Claim 93) of co-pending application 10/670,795 ('795) is different from the wet etching step recited in the instant claims. For that reason, the secondary reference of Yu et al. was relied on for the teaching of a wet etching step. As asserted in the rejection, it would have been obvious to one of ordinary skill in the art to make the etching step recited in Claim 104 of '795 a wet etching, as taught by Yu et al. (Column 3, Line 66 - Column 4, Line 10), in order to perform a selective etch that does not require masking of the substrate and does not damage other features of the substrate (ex. source/drain areas).

***Conclusion***

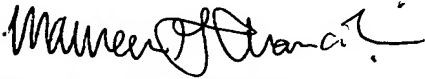
11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. U.S. Patent 6,764,898 to En et al. teaches a method of modifying a high-k layer by ion implantation, and then removing the modified layer by wet etching. (Column 12, Lines 15-57; Column 13, Lines 24-39) U.S. Patent 6,656,852 to Rotondaro et al. teaches a two-step method of removing a high-k layer, wherein the first step can be a plasma etching step, and the second step can be a wet etching step. (Column 4, Lines 25-53)

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maureen G. Arancibia whose telephone number is (571) 272-1219. The examiner can normally be reached on core hours of 10-5, Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571) 272-1435. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



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